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ABSTRACT

AFTHER, a computer simulation game for dealing with the complexities of higher education in a changing electronic world, is described. It is a tool for decision research and decision assistance. AFTHER enables the users to study higher education governance and its decision-making patterns in general, or to readily convert the simulation to an institution's particular characteristics and problems. This individualized conversion, used for teaching, decision research, or decision assistance, can be done without knowledge of computer language. Within the parameters of the game model, the computer can reprogram itself in all areas and dimensions of analysis and readily accept modified or revised data for institutional analysis. The simulation procedure, simulation elements, advantageous features, and research and development implications are detailed. (Author/MSE)

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AFTHER

A Decision-Making Game for Higher Education

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AFTHER g. manny gurne

Abstract

Higher education is changing rapidly and the new electronic technology is one of the most powerful change forces. Cohen, March, and Olsen* have demonstrated that certain aspects of higher education research in the future will in part be dependent upon our ability to develop, from the new technology, complex manageable models of rational decision making and the social and institutional realities we study. The use of computer simulation games is one manageable approach to dealing with these complexities; computer simulations are capable of compartmentalizing and automating complex rational decision models to provide practical utility to actual decision makers. AFTHER is just such a game; it is also a tool for decision research and decision assistance. As a dynamic but simplified interacting, computer simulation, AFTHER enables the users to study higher education governance and its decision-making patterns in general, or, to readily convert the simulation to their own institution's particular characteristics and problems. Furthermore, this individualized conversion (for the purposes of decision teaching, decision research, or decision assistance) can be accomplished without any knowledge of computer languages. Within the parameters of the AFTHER game model, the computer can actually reprogram itself in all areas and dimensions of analysis and readily accept modified or revised data for analysis of institutions in general or of any specific college or university. By simply typing, in English, the relevant variables and data, the user can create a simulation of any institution and its particular environment. The program then sets up the simulation to allow immediate use. And AFTHER is much easier to play than canned statistical packages, since all the instructions, commands, and operations are also in simple English.

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*Cohen, Michael D., James G. March, and Johan P. Olsen: "A Garbage Can Model of Organizational Choice," Administrative Science Quarterly, vol. 17, no. 1, pp. 1-25, March 1972.

AFTHER

A Decision-Making Game for Higher Education

g. manny gunne

Higher education is changing--more rapidly and radically perhaps than ever before. New and more types of students are attending colleges. Different agencies are increasingly intervening in campus policy and governance. Innovative approaches to instruction and credentialing are taking place. The lawyers and the legislators are determining significant institutional issues. Many varied forces are obviously causing vital changes in traditional college and university operations and performance. Kerr, commenting on these dynamic conditions, has identified one of the most powerful forces for change in higher education:

> ...the new electronic technology, which has brought about the first major technological revolution to affect higher education in the 500 years since the Gutenberg Bible....Electronic technology has greatly affected research, is affecting administration, and will increasingly be used in instruction.[1]

As Kerr suggested, this new electronic technology is beginning to affect not only instruction and research, but also administration and institutional decision making. Now, the electronic technology is being employed to research and assist institutional decision making. Until very recently most higher education researchers have been seriously limited in their attempts to study the complex interrelationships of decision-making in higher education. Even with the aid of the new technology, many of them may have been intimidated or "turned off" when trying to employ the machinery and learn computer languages or to think technically with the proficiency that would allow them to develop the sophisticated computer simulation

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[1]Kerr, C. "Administration in an Era of Change and Conflict." Educational Record. Vol. 54, pp. 38-46, 1973.

programs for their research. To undertake the development of these seemingly essential skills, they assumed, would be the near equivalent of pursuing a second professional career, involving perhaps as much training as their primary discipline. It is, therefore, understandable that many of them were consequently denied one of the most powerful tools available to development of research in their field.[2]

Studies of various aspects of the field of higher education can be advanced rationally and efficiently with an increased use of the computer.[3] The human brain is virtually incapable of conceptualizing the complexity and detail of entire social systems and much less able to adequately manipulate the extensive data sources such conceptualizations entail. As a result, rational decision-making is viewed as an ideal which is encouraged but seldom practiced and hardly attainable. The harried decision maker typically employs an intuitive approach that Lindblom describes as disjointed environmentalism[4] and Selznick refers to as satisficing:[5] doing what is humanly possible under the social circumstances.

Future studies in higher education will depend partially and increasingly upon our ability to develop complex, rational models of the social and institutional realities we study, and, a sophisticated, yet practical way to handle such complicated models is to computer automate them.

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[2]This is not to deny that many researchers do use the computer to make rather superficial analysis of data using available statistical programs; such applications, however, involve only a very limited use of the real power of the computer in the social sciences.

[3]Cohen, Michael D., James G. March, and Johan P. Olsen: "A Garbage Can Model of Organizational Choice," Administrative Science Quarterly. vol. 17, no. 1, pp. 1-25, March 1972.

[4]Perhaps the best description of this thesis occurs in Braybrooke, D. and Lindblom, C.E.: A Strategy of Decision. New York: Free Press of Glencoe, 1963.

[5]Selznick, P., Leadership in Administration. New York: Harper & Roe, 1957.

Computer-based simulations can be employed to model social systems at a level far surpassing the existing capabilities of any individual thinkers. We can now transform static conceptualizations and theoretical themes into dynamic computer simulation models based upon elaborate and complex data sources from our rapidly changing environmental conditions. With these models as our basic tools we can manipulate vast arrays of data into numerous conceptualizations and examine, at a very high level, the alternatives which are subsequently suggested. Taking advantage of the new electronic technology through computer simulation is a very effective way to study the dynamic interrelationships of our social environment and the relevant complexities of higher education within a rapidly changing society.

Presently, there are very few computer simulation models available to researchers and professors in higher education, and until now, the ones that were available were seriously flawed and extremely expensive to develop and use. Typically, most such simulations required technical languages and specialized machinery or personnel. These inconvenient aspects of the simulations effectively eliminated many potential users. Furthermore, most simulations were incapable of being readily adapted to apply to varying disciplines or fields of study or to accept different or revised data for particularized usage without extensive and costly reprograming by qualified specialists. All these drawbacks made simulation modeling of limited use, typically, for studies in higher education. The simulation AFTHER 1 was adapted to overcome each of those obstacles. In so doing, computers and computer simulation modeling are now available as teaching and research tools to the vast majority of personnel in higher education.

Foundation Model

A computer simulation for social scientists, called CASS 1 (Computer-

Automated Social Simulation), was developed at the University of Utah. This simulation eliminated many of the previous limitations of computer modeling and/or gaming and prepared the way for extensive development and study of rational decision making in numerous fields. For example, from CASS, AFTHER 1 was adapted. AFTHER, an acronym for "Alternative Futures and The Higher Education Response," is a computer simulation game dealing with higher education decision making and the future. In addition to understanding the basic elements of a rational decision-making model, the essential features of the game were designed to produce an appreciation for the complexity of higher education policy, planning, and governance as well as to increase an awareness of potential curricular program options for colleges and universities in the future, a future anticipated to be characterized by adverse economic and social conditions. The game includes many aspects of the real intricacies of educational decision making in a complex political environment, i.e., it interrelates the multiplicity and interactions of varied interest groups, the ramifications and repercussions of evolving social developments, the possibilities and probabilities for innovative programing, and the institutional impact of such cumulative events and conditions on the colleges and universities, and in particular, each of their many relevant constituencies.

AFTHER, the Game

Primarily, the game is conceived to simulate the relevant and realistic conditions at a "typical" public* higher education institution during the 1980-1990 decade. As the game begins, an innovative programs budget is provided to a select Program Innovations Council (PIC) which has been charged with considering which new program(s), among a list of twelve options

* It can readily be adapted to private institutions also.

available, should be initiated for the coming year. However, as intimated earlier, a decision to inaugurate any new program must be made while taking into account not only the costs and current priority status but also the many constituency interest groups (e.g., the faculty, students, community, and government agencies) which possess varying degrees of concern and control over programing. Such program decisions must also be made in consideration of emerging social trends and developments and subsequent troubles within the environment, the ultimate institutional effects on the internal constituencies, and the constantly restricted, if not dwindling, operating budget. Furthermore, as each simulated year (game round) passes with its positive and/or negative developments and cumulative ramifications affecting conditions and costs, and, the impact of the previous years' decisions are realized, two more program options are added to the original list to maintain a minimum of ten to twelve new program possibilities from which to choose annually.

The objective for the council of players is simply to determine how to judiciously expend the restrictive funds on innovative programs which will have high institutional effects while not aggravating or alienating the various constituency groups or being devastated or dismayed by the emerging social developments. The select council has, by the way, certain direct or indirect control over all of the important game variables--just as in life! And valuable information is available on each of these variables--at a cost, and influence levels of the constituencies may be altered through various means but also at some expense.

Considering all the interrelationships, it is up to the players of the game, as members of the Program Innovations Council, to decide which programs are most appropriate under the evolving conditions. The council is also expected to take into account the fact that education and economics

have never been very compatible; yet cost-benefit analysis does play a significant role in the game.

Simulation Procedure

The simulation models an environment in which decision-makers, the innovation program council members, are responsible for selecting programs from a list of available options or edgrams (educational programs) which maximize the positive effects within the institution and upon the constituencies according to certain policy priorities and related costs. In the game, the players or decision-makers choosing the edgrams with the most institutional benefits, the highest constituency satisfaction, and the optimum cost effectiveness rating during the decade rounds (years), score more points and win the game.

In its mechanics, the simulation has ten basic divisions.

1. In the introduction, the computer informs the user of the institution (or system) being simulated, the persons adapting the model, the place of adoption, and special instructions detailing how to begin and end the simulation.

2. The model proceeds to a presentation of any social developments[6] which may have occurred to affect the institution and the environment being simulated. Trends and developments occur in the game according to a preset method of statistical probabilities.

3. The first twelve program options and their associated optimum costs, if included, are considered next by the computer and presented to the players. The thirty decision options are presented incrementally

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[6]These trends or developments, as well as related costs, may be included or excluded depending upon the needs of the playing designer(s). If included, any or all may have effects on any of the priority levels, and developments may also have associated costs which affect the budget.

beginning with the first twelve and adding two additional options annually. It is possible to run the decision analysis or play the game for ten simulated rounds or years, 1980-1990. When costs are considered, decision options may be implemented at any funding level considered appropriate within the allotted budget, and effects vary in a linear or curvilinear fashion according to the ratio of the actual funding to the optimum. This interrelationship, as well as the budget and all other elements of the game, can be preset in the simulation design through simple English language instructions.

4. Four types of useful information are also available to the players: a) PRIORITY STATUS LEVELS describes the percentage or ratio of influence each constituency group (students faculty, etc) possesses at any stage in the game; b) PROGRAM EFFECTS ANALYSIS reveals the relative impact (effect) of selected programs on the seven constituency groups and the institution; c) STRATEGIC MOVES RESEARCH rank orders and lists the options available according to how likely they are to produce specified effects; d) PRIORITY LEVEL MODIFICATION discloses any changes occurring in constituency group influence percentages or ratios of significance. A punitive cost is exacted, as in life, for access to such data.

5. The priority modification routine allows the user to spend a portion of the budget to cause a desired modification of priority levels associated with any of the areas of effects in all the dimension categories. The resulting change is permanent (unless again modified through the same procedure) and costs a prearranged percentage of the budget for each one point change realized in priority levels.

6. During the game, when a specific program is implemented, the computer will reveal the consequences of the decision with the following

analysis: a) the rank order of the program chosen from among the alternatives available in each prioritized dimension of analysis, and b) its rank order in the overall cost-effectiveness analysis.

7. Success or failure of a decision or edgram option is a part of the simulation which may also be included or excluded. An option fails if both the average of its effectiveness rankings in each of the dimensions of analysis and its overall cost-effectiveness ranking are below the 50% mark. If it fails, half its satisfaction points are lost as well as all its effects.

8. The computer then proceeds to summarize all points earned or lost, priority level changes, and the resulting budget. Savings and debts from one round to the next is another option which may be included or excluded in the simulation's initial design. If included, interests of 5.5% on savings and 10% on debts is calculated and incurred.

9. The computer then proceeds to the next year or round. If all rounds in the original design are completed, the computer makes a final summary of all changes in the simulation and compares the decision-maker's final score to the last ten groups to use the simulation.

10. The computer statistically summarizes all moves and decisions which were made during the course of the simulation and suggests where overall improvements are possible.

Simulation Elements

As suggested earlier, AFTHER 1 considers interrelationships among four basic elements: options, costs, effects, and priorities.

1. DECISION OPTIONS. In AFTHER 1 there are thirty educational program choices (edgrams) or options which may possibly be recommended for implementation by the PIC. The curricular alternatives include such programs

as "Women's Programs," "Solar Energy Research," or "Faculty Evaluation." Each decision option has related costs, effects, and priorities associated with its implementation, and no decision can be made without consideration of these interrelationships.

2. COSTS. Each educational program option naturally has a price tag: this is the resource investment that is drawn from the annually allotted and often limited innovative programs budget.[7]

3. EFFECTS. This element is concerned with the comparative importance of the impact of each decision on the seven constituencies and the institution in general. For AFTHER 1 there are the two dimensions of effects: constituency and institutional. The basic model actually allows for six effect dimensions of twelve effects each with seventy-two effects possible overall. The AFTHER 1 version considers, in one dimension of effects designated as CONSTITUENCY, the specific impact of all programing decisions on the "state legislature," "faculty," "students," "community," and so forth.

AFTHER contains twelve developments, randomly implemented, that may affect any of the priority levels associated with the dimensions of analysis. Social occurrences of significance in the total environment being simulated include inflation factors, enrollment drops, legislative shifts, and others. Effects are computed on a scale of ± three, with zero indicating no priority.

4. PRIORITIES. The priorities are the ranked values representing a policy, perspective, or attitude associated with the PIC reflected against the decision options to produce the related effects on the constituencies and the institution. The priorities determine, as a result of the decision

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[7]This cost element need not be included when relative costs are considered non-applicable. When costs are considered, effects are weighted by the priorities and then divided by the costs to produce an overall cost-effectiveness rank. In the gaming version, this rank is the basis for calculating points, which determine how well the game is played or how effectively the decisions are made.

options, the relative impact of the selected programs in each effect area, both within and between the effect dimensions. Priorities are weighted on a scale of ± ten, with zero indicating no priority.

Advantageous Game Features of AFTHER

Much as canned statistical packages have allowed social scientists to use computers to analyze data, AFTHER 1 affords users (students, faculty, researchers, and administrators) the potential of developing computer simulations without any knowledge of computer languages. Within the parameters of the AFTHER 1 model, the computer will reprogram itself through simple English language instructions in all areas and dimensions of analysis and readily accept different or revised data for analysis. For any type of institution or system, the user can create a simulation by simply typing in the relevant variables and data. The program then sets up the new simulation.[8]

In order to facilitate maximum utilization and approach reality, AFTHER 1 employs a game model that simulates, for the field of higher education, many of the conditions of a rational decision-making logic. While the particular content of the simulation can be left up to the user, the basic paradigm of AFTHER 1 is a game of potentially optimal, rational, and realistic human decision-making. The simulation allows users to explore cause-effect relationships, measure cost-benefit analyses, study the impact of a number of influence groups simultaneously, experiment with alternative decision-making patterns, vary selected priorities, explore the effects of developments, trends, priorities, and values on decision makers and processes,

[8]The resulting simulation game is, coincidentally, quite inexpensive to arrange and run. The game can be played for about five dollars per run, and, for a mere twenty dollars in computer time, a completely new simulation can readily be adapted.

assess the consequences of alternative strategies in decision-making, and use a variety of quantitative techniques to study numerous variables and alternatives involved.

Research and Development

It should be specifically noted again that AFTHER 1 allows users to completely change the simulation through the use of simple English commands to model any desired institution or particular social-political environment. If users wish to redesign or build a new simulation, they simply type CHANGE and the computer will respond:

> WHICH PART OF THE SIMULATION DO YOU WANT TO CHANGE: 1) PARAMETERS, 2) LABELS, 3) EFFECTS, 4) PRIORITIES, OR 5) COSTS?

By altering all five of these elements in some facet, a new simulation can be developed. The computer will automatically reprogram itself and the new version, crediting the new designer(s), is immediately available for use. It is easy, therefore, for a person without any computer language skills to completely design a complex computer simulation for research and analysis of environmental system conceptualizations based upon available data within a particular state, community, or institution.

Conclusion

AFTHER 1 is an outgrowth of five years of development of computer simulation models by the authors. It is completely automated and will run on any direct interaction, time-sharing computer which has an APL (a computer language) compiler. The actual computer program was written in the APL language because of APL's advance capabilities for handling large matrices of interrelationships and because of its ease of use in simulation design and redesign in English. The model requires an APL workspace availability of approximately 140,000 bytes, but can be adapted to a much smaller

workspace through the use of files. The simulation is run directly from a console computer terminal or when portable terminals are used, the simulation can be run anywhere in the nation by standard telephone connections simply through dialing-in the nearest appropriate computer facility. A manual for use with AFTHER 1 is available with the computer program.

With AFTHER 1, as currently designed or by inserting selected variables and values, a player can use the model to understand the specific decision-making dimensions being manipulated. The simulation can subsequently be used as a teaching device to help students appreciate the complexity of decision-making within institutions of higher education, recognize how alternative approaches, developments, and values affect decision outcomes, and acknowledge the importance of rational analysis in decision-making. It can also be used in research to explore alternative theoretical conceptualizations within the limits of existing data and thus indicate directions for future research.

Finally, AFTHER 1 can be used as a decision assistance tool to help decision makers analyze the potential consequences of alternative decisions. Specifically, as a game, AFTHER 1 permits users to (1) utilize a variety of quantitative techniques in the analysis of higher education decision-making, (2) explore cause-effect relationships of curricular changes, (3) measure cost-benefit analysis, (4) study the various effects of many different pressure groups simultaneously, (5) experiment with alternative decision-making modes as well as variations in program implementation, (6) determine how different priorities, developments, and values affect decision makers and their constituencies, and (7) learn the processes involved in assessing the consequences of alternative strategies in a particular facet of institutional decision-making.

The model can be adapted for teaching, research, and assistance, but it cannot be used as a substitute for human decision-making or ever employed to automate actual decisions. While the model can aid in the consideration of the consequences of particular choices, and, thereby facilitate and possibly optimize rational decision making in higher education, it cannot actually make decisions; making real decisions in higher education is not a game.